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Review article

Assessment of water resources development and exploitation in Nigeria: A review of integrated water resources management approach

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ABSTRACT

This research aims to review the current state and limitations of water resources management in Nigeria and explore how adopting an integrated approach to water management can strengthen socio-economic development. As the support for integrated water resources management (IWRM) grows, it is necessary to explore how feasible it is in the Nigerian context especially with many Nigerian states facing water stress even with the country's substantial resources. This paper reviews literature related to the implementation of IWRM around the world with particular reference to developing countries in Africa and draws parallels between their experience and the possibilities that exist for IWRM in Nigeria. Progress on adopting IWRM in Nigeria is discussed and the pitfalls to implementing IWRM in practice are identified. Among the hindrances to effective water resources management in the country is the lack of good water governance, which has affected the quality of water legislation and institutions. This paper concludes that the slow progress of IWRM implementation in Nigeria is the result of an unclear framework for implementing IWRM in the country. This paper recommends an iterative approach to implementing IWRM that allows for adaptation and is tailored to solve specific water problems in Nigeria.

1. Introduction

The sustainable management of water resources is critical to the development of a society because water plays a key role in various aspects of human endeavour. Water is needed for domestic, commercial, industrial, agricultural and recreational purposes. All developed nations have a shared history of heavy investment in water infrastructure, institutions and the capacity to manage water resources adequately [1]. Conversely, less developed nations are usually characterised by inadequate water infrastructure, weak institutions and poor water governance. Given that the demand for finite water resources is increasing, it is important to examine how water resources can be managed to facilitate continued national development.

In Nigeria, the total renewable water resources (TRWR) per capita is estimated to be 2514 m^3/year yet access to clean water is reported to be low with only 69 per cent of Nigerians with access to basic water supply service [2]. In comparison, countries like Tunisia which have significantly less TRWR per capita have achieved near nationwide coverage of water supply services [3]. Judging by the poor access to water supply as evidenced by [3] and [4], and the continued degradation of the available water resources, it can be inferred that there are critical issues with the way water resources are managed in the country. At present, the Federal Ministry of Water resources oversees all water resources development and management in the country through other smaller ministries and parastatals. Consequently, sectoral interests and lack of coordination among stakeholders hinder effective water resources management, resulting in over-abstraction and wastage of water resources, and environmental pollution which negatively affects essential ecosystems [5, 6]. Although the country is blessed with vast freshwater resources estimated at 286.2 km^3/year, these resources are not distributed evenly geographically and are subject to seasonal variability. The northern region of the country faces this more sorely as annual precipitation averages between 100 – 250 mm and the high population in this area has resulted in water stress [7]. Furthermore, a growing population and urbanisation are putting increased pressure on the available water resources such that there is competition across multiple sectors for water resources and access to water is restricted even in areas of the country where water is abundant [6, 8].

In line with these trends, there is a needed paradigm shift in water management from the traditional, sectoral approach to integrated water

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resources management (IWRM) with the belief that implementing its principles will translate to sustainable use of water resources [9].

This research, therefore, examines the current state of water resources management in Nigeria, its effect on national development, and how implementing IWRM can benefit sustainable development in Nigeria. Key considerations are the uniqueness of the Nigerian context and the intrinsic factors that could pose a hindrance to the implementation of IWRM. The following sub-themes are explored in this paper: the policy and legal framework of water resources management in Nigeria, the characteristics of IWRM and how they translate to national policy, lessons to learn from other developed and developing countries which have adopted IWRM principles, and how implementing IWRM can fuel national development. This paper is based on a review of pertinent literature describing the IWRM approach and how it has been implemented around the world. Other published works including legislation laying out the structure and responsibilities of relevant water-related government agencies in Nigeria are also reviewed. Figure 1 shows the map of Nigeria in the context of its location in Africa as well as globally.

2. Water resources management in Nigeria

2.1. Colonial-era and independence

Organised water management in Nigeria predates the country's independence in 1960. As far back as 1849, the colonial masters collected water and stored them for domestic use through roof water harvesting. Over time, it graduated to intake from streams and later in the form of a more complex simulated artesian piping system [10]. Subsequent increases in the population resulted in the creation of the unit for water services in the Public Works Department (PWD) in the 1950s. After political independence in 1960, the Ministry of Works integrated the water services unit of the PWD [10]. Currently, the Ministry of Water Resources at the federal level and the Ministry of Works at the state levels oversee the issue of water management in the country.

2.2. Current scenario of water resources management in Nigeria

Following the independence of Nigeria in 1960, the River Niger and Lake Chad Basin Commissions were established followed later by the Sokoto-Rima and Chad Basin Authorities in 1973 and 1974 respectively. It was the responsibility of the River Basin Development Authorities (RBDAs) to exploit, develop and manage the available land, surface and groundwater resources in their areas of jurisdiction to improve agricultural output and provide water for various other purposes as shown in Table 1 [11]. Nigeria's first comprehensive steps into regional water policy development came in the mid-1970s with the establishment of eleven (11) RBDAs by Decree 25 of 1976 and subsequently, the Federal Ministry of Water Resources (FMWR) in 1976. The RBDAs came in response to the Sahelian drought in the early 1970s. Between 1976 and 1979, the RBDA Act had been amended once in 1977 (Decree 31 of 1977) and repealed by Decree 87 of 1979. The Act was repealed again in 1986. Finally, the current RBDA Act of 1990 divided the Niger River basin into the Lower and Upper Niger River basins bringing the total number of river basins and RBDAs to 12 [12]. According to the National Water Policy, 2004 [11], the Water Resources Act of 1993, the Minerals Act of 1990, the RBDA Act of 1990, the NIWA Decree 13 of 1997, and State Water Edicts are the only statutory laws governing the development and management of water resources in Nigeria. Under the Water Resources Act of 1993, the Federal Ministry of Water Resources (FMWR) is given the sole responsibility for both the development and management of water resources in Nigeria [13].

As is the case in many developing countries, the FMWR oversees a number of smaller agencies and parastatals, each one concerned with a specific water use, in a top-down management approach. Effective water resources management is hinged on making the right policies to guide the management institutions, and this is one key element that is lacking in the Nigerian context. Various authors have cited weak legal and institutional framework as a significant setback in the way water is managed in Nigeria [8, 14, 15, 16]. The weaknesses have resulted in public institutions that are crippled by overlapping functions (Table 1), lack of funding, vested political interests and corruption, technological deficit, and absence of a comprehensive database for planning to the end that the water resources of Nigeria are grossly under-utilized or wasted and further degraded by pollution [6, 17, 18].

Lack of continuity in policy implementation has made it difficult for state governments such as Imo state to rise above the provision of 24 L daily per person as against the World Health Organisation (WHO) standard of 130 L and 70 L per person/day for urban areas and rural areas respectively [10]. A water-rich Nigeria with an estimated 267 billion cubic metres of surface water supplies and 52 billion cubic metres of groundwater supplies [6] currently suffers from poor water governance, weak policy formulation, and lack of implementation as it concerns efficient water use. Poor water governance and the resultant water scarcity is contributing to the security challenges in Nigeria particularly in the North-eastern region with Boko Haram terrorist insurgency, herdsmen killings, and the sacking of farming communities around the country [20].

2.3. Demand and supply management challenges

According to Muller et al. [21], water resources management at its core is finding an acceptable way of maintaining regular supply of

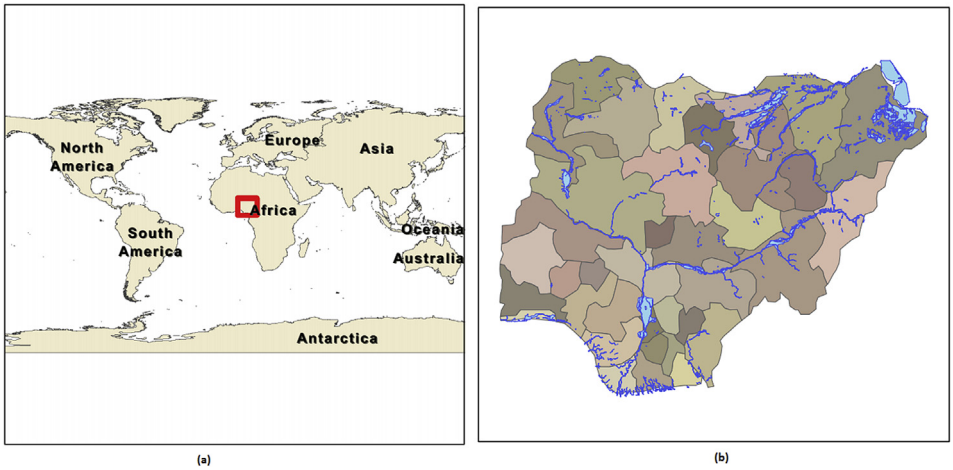

Figure 1. (a) The map of the world showing the location of Nigeria in Africa (b) The map of Nigeria showing the states and major water bodies.

Table 1. Primary Water Resources Management Statutes in Nigeria and their functions.

Statute	Year Enacted	Description with respect to water resources development
The Water Resources Act	1976, 1993	The act established the FMWR and gave the ministry the responsibility of overseeing water resources management in the country, providing water for various uses, collection of basic hydrological data, and to coordinate the activities of all other water resources agencies.
Minerals and Mining Act	1990	The act empowers the Mining Cadastre Office (MCO) to issue water use permits, among other functions.
The River Basin Development Authority (RBDA) Act	1990	The act established 12 RBDAs and empowered them to develop and manage surface and groundwater resources within their jurisdiction to promote agricultural development and provide domestic water supply.
Nigeria Hydrological Services Agency (NIHSA) Act	2010	The act enables NIHSA to collect and store accurate and reliable hydrological and hydrogeological data on the status and trends of water resources development in the country.
The Nigerian Meteorological Agency (NIMET) Act	2003	The act established NIMET as an organ to advise the government on meteorological issues, issue weather and climate forecasts, collect, collate and disseminate meteorological data, and encourage meteorological research to support socio-economic development in the country.
State Water Edicts	Diffuse	Each state including the FCT has policies uniquely tailored to meet the water needs of their respective localities. These policies are implemented without prejudice to the Water Resources Act.
The National Inland Waterways Authority (NIWA) Act Cap N47	2004	The act empowers NIWA to supervise facilities and indigenous technical and managerial human resources needed to meet the challenges of modern inland waterways transportation.

Source: [10, 11, 19].

freshwater against the backdrop of increasing demand. Traditionally, water resources management in Nigeria is supply-biased rather than demand-oriented [22]. That is, more emphasis is on increasing the quantity of water that is available for consumption through developing new infrastructure rather than ensuring optimal use of the available water resources. This gap between supply and demand management is one of the critical issues in water governance raised by researchers not only with respect to Nigeria but also with other rapidly urbanising countries [22, 23]. Currently, water managers in the country are not fully subscribed to either demand and supply management of water or IWRM. This lack of a clear direction is, in part, because of the absence of political will to accept fully the use of marginal cost recovery in pricing water as an economic resource. With a population growth rate estimated at 2.6% per annum [24], the demand for water in adequate quantity and quality for various purposes (domestic, municipal, agricultural, commercial and industrial) is increasing [25, 26] whereas, available resources are being depleted due to factors such as climate change, over-abstraction, and pollution [22]. For example, the former governor of Imo state in Nigeria observed that it met a zero level water supply from the state water corporation (SWA) since taking office in May 2019 [27]. Other 35 state governors in Nigeria may not have voiced their lamentations, but the scenario is not likely to be different. This gap in water supply is being filled in part by private organisations including small and large water companies, and water tanker operators; a situation similar to what is being witnessed in the urban water supply sector in Ghana [28]. These private enterprises, however, are primarily concerned with making commercial gain without considering the impact of their continued groundwater abstraction on the sustainable development and use of scarce water resources. Muller et al. [21] describe supply management as increasing supply by the provision of more storage, water transfer, desalination and reuse of waste, and use of the natural environment by sustaining freshwater sources. However, this approach pays little attention to cost recovery and has serious repercussions for the environment and the economy [29]. Given that it has become unsustainable to continue to increase abstractions from finite freshwater resources, the attention now is on how to manage the demand through structural and non-structural means in order to drive sustainable use of water resources. The control of demand will require household tariff increases, improved and reliable industrial supply, application of technology to monitor and improve the efficiency of water use in agriculture, and trading of water allocation by price mechanism [21]. Nevertheless, there are arguments against both supply and demand management of water that they do not guarantee marginal cost pricing to take care of the environmental concerns which affect future availability and use of the resource [10, 29].

3. Concept of integrated water resources management

Water is a vital requirement for human existence. As such, water resource managers over the years have searched for ways to exploit this essential resource for its numerous benefits to man and the environment while taking into account its uneven spatiotemporal distribution and finite nature [29]. The likelihood of having water disaster across the world has pushed water managers to search for effective ways of meeting future needs without sacrificing the security of current water supplies [10, 29]. To this end, the argument has been, how to balance the supply and demand forms of water management in order to guarantee maximum possible benefit from water resources while preserving ecological systems for future use [10]. In practice, in Nigeria as with many developing countries, there is a distrust of demand-oriented water management as it is usually seen as the prescription of international donor organisations like the World Bank, World Health Organisation, and the International Monetary Fund to keep developing economies in perpetual poverty [10].

In the latter part of the twentieth century, it became apparent that the world needed to pay more attention to ensuring sustainable use of water resources in order to prevent a global water crisis. This was a key theme in the United Nations Conference on Water which held in Mar del Plata, Argentina in 1977 where several issues surrounding integrated water management were discussed. This included, among other topics, the need for policy and legislative instruments that promote integrated water management, the importance of ensuring real co-ordination among all water institutions, and public participation in water management. An action plan was developed which included recommendations on key issues in water management and twelve resolutions on varying subject matters ranging from efficiency in water use to encouraging stakeholder participation through education, and public information. The Mar del Plata action plan is therefore widely recognised as the first internationally coordinated effort to IWRM [30, 31]. Following this, at the International Conference on Water and Environment that held in Dublin, Ireland in 1992, four principles were introduced that have underpinned a lot of the water sector reforms. These principles emphasize that: water is an important natural resource which is finite and vulnerable, management of water resources should involve all stakeholders, involving women in water management is key to maximising the potential in the water sector, and water should be seen as a resource with economic value [32].

In a bid to provide an clear definition of IWRM, which had hitherto been lacking [33, 34], the Global Water Partnership (GWP) described IWRM as:

"*... a process which promotes the co-ordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare of a people in an equitable manner without compromising the sustainability of vital ecosystems*" [34].

IWRM is therefore concerned with how to allocate water and water infrastructure in a way that reduces wastefulness, thereby contributing to the sustenance of the environment. The concern for efficiency is based on the fact that this "finite" material has contributed to human civilization in the following ways: economic production in industry, agriculture, mining, domestic use for drinking and cleanliness, transportation and commerce, communication, naval, power and energy generation, economic power and wealth creation and rise and fall of political forces. All these contributions to civilisation are without borders hence Nigeria has benefited aside other contributions by becoming one nation of diverse people during the colonisation era. Although critics have argued the impracticality of IWRM especially in developing countries [35], the concept of IWRM as a way forward has advanced across the world as it plans for current demand while ensuring the safety of the resource for future use.

3.1. Characteristics of IWRM in Nigeria

Political considerations are often at the heart of discussions to embark on a new water scheme in Nigeria rather than the input of experts [10]. As a result, hard paths (i.e. large-scale water infrastructure) are commonplace while soft path solutions (i.e. policies and institutional reform) are absent. Other indications of lapses in the process of deciding new water schemes include lack of cost recovery measures, use of outdated irrigation processes and absence of water recovery measures, and inequality of stakeholders on issues of water supply and use which is a key part of the SDG [36, 37]. The centralised approach to water resources management practiced in Nigeria and the limited inclusion of private participants is a major part of the water problem in the nation. Although government monopoly in the water sector is reducing with the entrance of small and large private enterprises, there are still significant hindrances to private sector involvement. These hindrances include the need to ensure equitable distribution of resources all over the country as well as other political considerations such as providing subsidies to poorer areas. In addition, the perception of water as a social good, the need for large capital investments in the sector, and the interdependence of water uses as seen in the conventional lack of property rights in the water supply industry could discourage private sector entry into the sector [10, 37].

In Nigeria, IWRM is currently seen as a scheme imposed by the World Bank and other funding agencies that has demand, supply, and cost recovery items without sustainable supply for future use in terms of environmental remediation and recharge of the system [10]. The National Water Policy [11] limits the functions of River Basin Development Authorities to the control, development and conservation of land in Nigeria's surface and underground water resources to upgrade agriculture and water supply output. In summary, some of the characteristics of integrated water resources management argued by Muller [21] and [38] are holistic management of all water sources in a country with the river basin as the basic unit of management, synergy of various water users, planning of water development with respect to the broader national framework. Other characteristics include pursuing economic efficiency, equitable distribution of water especially across vulnerable groups, and promoting environmental sustainability especially in the age of global climate change mitigation and adaptation.

3.2. Assessing IWRM in Nigeria

The United Nations [39] report on integrated water resources management programme progress indicates that most African countries including Nigeria have medium to low progress in the range of 31–50%. According to the progress report, the countries within this range have institutionalized most elements of IWRM at 41 percent but are unlikely to meet the global target except a significant acceleration of progress is made. South Africa has however been classified in the range of 51–70% of implementing elements of the IWRM in long-term with the possibility of reaching the 2030 target if sustained efforts are focused [39]. The emergence of IWRM at the global stage [40] was to guide discussions and policy formulation as it concerns sustainable water resources management in the absence of an alternative road map. The key features of IWRM as noted by [41] include integrating water issues with other policy objectives, good governance principles, stakeholders' involvement in decision-making, including women, efficient allocation of resources with cost recovery that assures of equitable access, and sustainable demand management principles. Cherlet [42] has noted that over 80% of countries worldwide use the IWRM principles in their water laws while two-thirds of countries have developed a national IWRM plan since the turn of the century. Notwithstanding the widespread diffusion and adoption of IWRM around the world, questions are being asked about the efficacy of this single solution in all parts of the world with different economic, socio-cultural, and environmental experiences [14, 35]. This calls for an assessment of the level of adoption and implementation of IWRM in Nigeria. Akpabio et al. [14] and Biswas [35] argue that the heterogeneous nature of the country, including its different cultures, the skewed availability of natural resources, investment funds, management capacities, and institutional arrangements, may hinder the adoption of a single solution to a complex water resource challenge. In Nigeria, aside from these factors, governance, legal framework, decision-making processes and types, and effectiveness of institutions have geographical differences [14, 35]. All these factors have both negative and positive effects on the effectiveness of water resources management in Nigeria.

The evolution of IWRM principles in Nigeria started with the establishment of two RBDAs, followed by the establishment of the Federal Ministry of Water Resources (FMWR) in 1970, and subsequently the increase of the number of RBDAs to twelve [12]. However, the term "IWRM" was not mentioned in Nigeria's earlier water legislation but was later recognised in the first National Water Policy in 2004 [43]. This National Water Policy defines IWRM as "integrating the different users and uses of water resources" [11]. While the policy document did not explicitly state that IWRM principles would be adopted, the principles of participatory water management, transboundary river management, and environmental sustainability were highlighted therein. While these principles are outlined, the current water legislation does not state in clear terms how these principles are to be achieved in practice [44].

The operation of the RBDAs is particularly important because the river basin is often seen as the most practical geographical unit for implementing IWRM. Figure 2 shows the 12 river basin development authorities in Nigeria and their area of coverage.

Initially, the RBDAs were instituted to provide bulk water supply for agriculture. However, their functions have since expanded to include collection and collation of relevant hydrological, hydrogeological, and meteorological data within their areas of jurisdiction [10]. A study carried out by Akpabio et al. [14] on the implementation of IWRM in the Cross River Basin Development Authority (CRBDA) showed that the RBDA could not carry out its responsibilities because of limited resources and the lack of technical capacity to collect and store relevant hydrological and hydrogeological data. Other RBDAs and water management institutions in Nigeria face similar challenges of inadequate technical support for effective operation.

Also, the fact that no dam project has been completed in the Southeast zone of the country out of a total of 200 dams in the country is an indication of the failure of the current water resources management system [10]. This situation typifies the weakness of the institutional arrangement of the Nigerian water sector, a weakness that reflects the centralised system of governance practiced in the country. According to Akpabio et al. [14] and Mitchell [45], this institutional arrangement is further affected by political, ethnic and economic considerations.

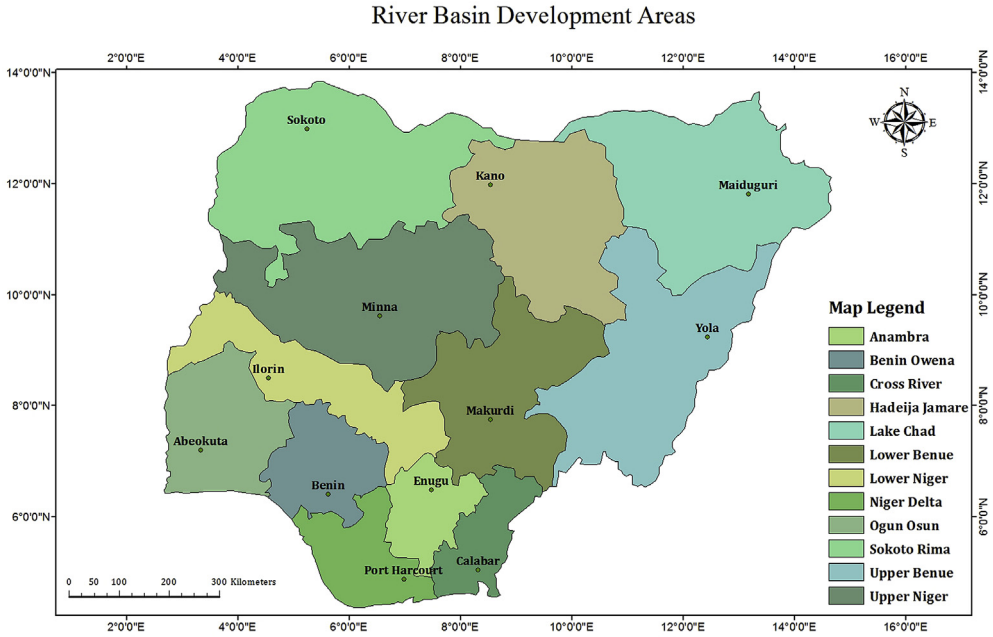

Figure 2. Map of Nigeria showing the locations of the 12 RBDAs and their area of coverage.

Moreover [14], argues that legal arrangements which deal with water, land and environmental resources in Nigeria are weak and do not recognise the intricate ecological linkages between water and other related resources such as oil. The effect is an uncoordinated management approach in policy formulation and implementation. It is noted that each river basin is supposed to be coordinating with the state agencies in its area of operation which are governed by by-laws and edicts the river basin authority does not have jurisdiction over [14].

Other IWRM issues of concern in Nigeria especially in the northern part of the country [46] include surface water demands exceeding mean river flow, river channel blockages which hamper downstream water use, the impact of large dams on river flows, decline in groundwater levels in parts of river basins, reduction in the number of hydrometric networks, and near absence of attention to groundwater data and management.

3.3. Examples of IWRM in practice in selected countries of the world

According to Winpenny [29], managing water as an economic resource is necessary to enable the suppliers and consumers of water to treat it as a scarce and valuable resource (commodity) with an economic value. Instead, consumers (demand-driven) treat water as a fundamental right while suppliers (water services agencies and operators) view water as a commodity that should be charged for appropriately at an economical rate which incorporates appropriate pricing [10, 29]. The IWRM argument is that water should be treated as an economic good with economic, financial and environmental benefits for the sustainability of life on earth. Agenda 21 of the Rio Earth Summit on Integrated Water Resources Management stated that the use of the resources should be in a way that promotes social equity, economic development, and environmental sustainability objectives of humanity [38]. An endorsement of this approach was made at the World Summit on Sustainable development in South Africa, 2002, which encouraged all nations to develop an IWRM plan by 2005. While South Africa developed its policy, legislation, and initial national water resources strategy as an example of a good IWRM scheme, the implementation has been limited by such factors as regional developmental choices, poor management of municipal infrastructure, and water quality issues based on pollution. The limitations are in the growing conflict potentials over scarce water resources in South Africa, both within the country and with its neighbours [21]. In Ghana, the implementation of IWRM has not progressed beyond the initial set up of the water resources commission and the conduction of baseline studies to determine the best strategies the government needed to adopt in the implementation of IWRM [47].

Developed economies such as Israel, several countries in Europe such as the United Kingdom, and the United States are already implementing the IWRM approach to preserve their precious water resources, and in the case of Israel, ensure its agricultural economy and national security [37]. These nations are working through effective water management to overcome food shortages, energy shortage, the effects of climate change, and learning how manage the earth's total environment sustainably. Research endeavours in these countries are geared towards meeting these needs through genetically modified crops that require less water, breakthroughs in desalination to provide water for crops and cities, free-standing small water turbines to generate electricity, clean renewable energy, and developing efficient water supply systems that allow for ecosystem renewal [37].

In the case of the USA, at the height of its demand and supply management of water, canals (Erie Canal, Panama Canal), dams of various sizes and shapes (Hoover dam, Colorado River, Grand Canyon), and central valley water transfer projects were built in California [37]. America used the dam technology to transform the arid far west part of the country's rivers into a dynamic engine of inexpensive irrigation, hydroelectricity, water storage and flood control system. Water, not free land, it has been noted [37] was the limiting factor in America's development. In American history, water had the effect of affecting the nation's economic growth, social wellbeing, political development and power, and military authority all over the world. All these human-made demand and supply management solutions created additional pollution problem from both point sources in agriculture, nuclear power plants, laboratories, hospitals, and domestic waste in cities and towns, which affected land, water, and air in the country. Finding solutions to this new challenge gave rise to a paradigm shift from traditional, centralised, mass-scale infrastructure that extracted, treated, and delivered more supplies from nature to a new approach hinged on more decentralised, scaled-to-the-task, and environmentally harmonious system that made greater use of existing supplies. The idea of efficiency brought home the need for an integrated water supply scheme [37].

In Britain, IWRM followed the same trajectory of adverse pollution challenges and water infrastructural rethink to arrive at the current water resource management system [37]. Benson and Jordan [41] report that

water reform in the United Kingdom started in 1930 with the National Land Drainage Act which created catchment districts and dedicated catchment boards responsible for managing flooding and surface drainage. By 1952, these catchment boards were replaced by regional River Boards and their responsibilities expanded to include control of pollution and monitoring water quality [48]. As such, climate change adaptation measures and flood risk assessments are integrated into river basin management in the UK [48]. Several revisions of the Water Act of 1973 and the National Rivers Authority law brought about the establishment of the Environment Agency of 1995 which became responsible for implementing government water policy. United Kingdom laws including that of the Environmental Agency of 1995 and its Water policy has been under the European Union since 1970s [49]. In effect, the EU laws that took effect in the UK through the European Communities Act, 1972 were given effect in the UK without the need for any further domestic legislation [50]. However, with UK exit from European Union (termed Brexit) which came into effect on 31st January 2020, it is suggested that de-Europeanisation of UK's laws including those on Environment will follow but with a longer process of disengagement [51]. It is necessary to observe that the European Union (Withdrawal Agreement) Act 2020 which gave effect to the earlier enactment of 2018 has a target date of at least 31st December 2020 in which the UK will continue to be bound by EU laws during the transition period for the negotiation of the terms of exit [50].

3.4. Hindrances to implementing IWRM in developing countries

The mission of IWRM has been to reconcile the different uses of water which are in competition through stakeholder participation and decentralising governance to the lowest possible hydrologic unit [52]. The implementation of IWRM in Ghana (a West African country with similar colonial history with Nigeria) is still slowly evolving with incremental management based on specific direction by donor funding agencies. In this regard, the various basin boards manage basin-scale approach while the water resources commission (WRC) coordinates at the national level [9]. Based on this approach, government organisations and agencies are more active stakeholders while local institutions can only make minimal contributions [9]. This system of governance is similar to what is practised in Nigeria, where political interests control the management process and other stakeholders have limited input. As noted by different authors [53, 54, 55, 56], this introduces endogenous factors such as water scarcity in terms of quantity and quality, conflict of usage with increased population and urbanisation, and transboundary use of water resources.

Another issue that arises from limited stakeholder involvement is that stakeholders at the grassroots then view the adoption of IWRM as the result of the prodding of donor agencies (such as the International Monetary Fund (IMF) and the World Bank) and an attempt at neo-colonialism by these agencies. Consequently, these marginalised stakeholders are unwilling to buy into the IWRM scheme and commit to the success of the programme [53, 54, 55, 56]. Structuring the decision making process around the political class has affected the implementation of IWRM such that its most important stakeholders – the people – are unable to take ownership of the concept and cannot see its relevance. Another relevant point of interest is that many of the underdeveloped nations such as Nigeria and Ghana whose water governance system can benefit greatly from adopting IWRM lack a proper understanding of how to implement IWRM in practice. This lack of understanding caused the basin authorities such as the RBDAs in Nigeria to lose focus by delving into too many things at the same time [9, 57].

Other operational inefficiencies hindering the implementation of IWRM include conflicting norms such as human right to water versus cost recovery, conflicting water sector laws and regulations, budgetary constraints to more capital-intensive needs of IWRM, lack of appropriately trained personnel, overlapping functions among institutions/agencies, and poor local capacity in terms of financial, organisational and political capabilities.

Based on the identified lapses in the implementation of IWRM in developing economies, the goal of the water management system should be adapting country-specific methodology toward the specific needs of country and using existing resources to address the priority areas [9].

3.5. Using IWRM principles to solve water problems at the basin-scale in Nigeria

Challenges are often a springboard for innovation and development. This can be seen in the Nigerian Northeast region which experiences severe water crisis that is aggravated by insecurity and terrorism (Herdsmen attacks on farmers, Boko Haram and Islamic State of West African Province - ISWAP) [58, 59, 60]. Lake Chad, in Africa's Sahel region which includes Nigeria, is noted to have shrunk in area by 75% from 25,000 square km to just 2,000 square km in the last three decades, not only because of periodic droughts but also because of massive diversions of water for irrigated agriculture [61]. The lake's once rich fisheries have collapsed entirely. The massive depletion of Lake Chad in Nigeria is an example of unsustainable exploitation of freshwater resources which challenges future freshwater availability [61, 62].

The construction of the Tiga and Challawa gorge dams in the 1970s resulted in severe degradation of the river Komadugu Yobe basin (which contributed to the recharge of Lake Chad) by 35% leading to decline in flow, abstraction of water for large-scale irrigation, and regional drying of the climate [63]. Fishing, farming and livestock-based farming activities have also been affected. The situation was worsened by the lack of government institutions to cater to the basic needs of the people within the six affected Nigerian states in the Chad basin [63].

At the beginning of the new millennium, the Federal Ministry of Water Resources, in conjunction with development partners, initiated intervention strategies to address these challenges [64]. The solution take-off point was to ensure that the results of the assessment carried out to ascertain the needs of the basin were available to all stakeholders to ensure transparency and stakeholders' commitment. Thereafter, pilot projects to solve the challenges on the ground and to ensure the delivery of livelihood benefits to the affected communities started. Such projects included clearing of aquatic weeds and infrastructure that were blocking the river flow, dredging channels, improving flood early warning, and developing conflict resolution strategies. To solve the problem of poorly organised and uncoordinated basin management, state IWRM committees were formed in each state based on the lessons learnt in the former fragmented water resources management approaches [64]. This action helped to accelerate the decision-making process at basin levels by bringing different stakeholders together who were able to reach a consensus on the strategic moves required for basin restoration and sustainable development of water resources in the region. The result of this was, by 2006, there had been a 90% reduction in the number of water conflict cases reaching the courts. The lessons learnt led to the setting up of the Nigerian IWRM Commission in 2008 to ensure inter-basin knowledge transfer and implementation nationally [64]. It is, therefore, necessary to understand that the successes recorded in applying IWRM at a small scale help to strengthen support and build confidence about applying IWRM at a broader scale through an adjustment to policy, laws, and institutional reform [63, 64].

4. IWRM and sustainable national development

Water resources play a vital role in fuelling socio-economic development [65]. Water when harnessed can be used for agriculture, electricity production, industrial processes, and domestic consumption. These multiple uses of water are in constant competition and failure to manage this competition will have adverse effects on human development. Koudstaal [66] highlights the need for both supply and demand

management of water resources as part of IWRM to further socio-economic development.

By unanimous decision, member nations of the United Nations adopted 2030 Agenda for sustainable development in 2015. The Agenda which comprises 17 sustainable development goals has 169 targets emphasising social, economic and environmental issues in development that seeks to end poverty, protect the planet and ensure prosperity for all [39]. Looking at the sustainable development goals (SDGs), the role of water as a vital resource can be seen through the links that exist between the SDG 6 (Clean water and sanitation) and the rest of the SDGs [67, 68]. Reaching the targets under SDG 6 will greatly facilitate the building of sustainable cities and communities (SDG 11), eradicating poverty (SDG 1), reducing inequality (SDG 10), ensuring good health and well-being (SDG 3), promoting gender equality (SDG 5), combating climate change (SDG 13), and ensuring that future consumption and consumption patterns are sustainable (SDG 12). This multidimensional nature of water and the need to manage it is captured in the SGD target 6.5 which states that "By 2030, the implementation of integrated water resources management at all levels, including through transboundary cooperation as appropriate is effected" [69].

Even though the concept of IWRM existed before the 1990s [14,35], its inclusion in the sustainable development goals has put it in the forefront of global agenda and will ensure that conscious action is taken in order to reap results that will translate to improved water resources management, water security, and environmental and socioeconomic benefits [52].

4.1. Water resources and sustainable development

From the first United Nations Conference on the Human Environment held in 1972 in Stockholm, Sweden, the issue of human impact on the environment and the need for collaborative environmental preservation has taken centre stage in world agenda. The United Nations (UN) taking the lead has spearheaded the establishment of the Earth's Summit connecting Heads of State and governments since 1992, ongoing intergovernmental studies of climate change from 1988, an influential commission on environmentally sustainable development in 1989, and the first comprehensive, five-year-long assessment of Earth's total ecosystem in 2000 that was completed in 2005. The efforts culminated in the United Nations publication of the first triennial world water development report in 2003 which was followed in 2005 by the launch of the International Decade of Water for Life [37]. Providing clean water and a healthy environment has become part of the standard measure of domestic legitimacy around the world as expressed in sustainable development goal 6, which is the linchpin of other goals as it relates to water.

From the UN Secretary-General Report on the Sustainable Development Goals (SDGs) 2018, out of the 157 countries covered by the report, the average implementation of IWRM was put at 48 percent. Based on the report also, 62 of the 153 countries covered by the data on sharing of transboundary waters, the average percentage of national transboundary basins covered by an operational arrangement was only 59% in 2017. As of 2015, the report indicates that 29% of the global population lacked safely managed sanitation services. It is therefore noteworthy to observe that post-war Japan had its economic miracle hinged on the intensive exploitation of its arable land and hydropower based on the construction of 2700 large dams. India's 4300 large dams were crucial to their development of food production that kept pace with the massive population growth. Other developing nations such as Egypt had the Aswan dam transform the Nile, Turkey's giant Ataturk Dam is the anchor of its regional transformation, and Pakistan's national pride is in the huge Tarabela dam on the Indus River. In South America, the water-rich Brazil-Paraguay border hosts the 1991 Itaipu Dam on the Parana River, which accommodates the world largest generator of hydroelectricity before the construction of the Three Gorges.

The world freshwater scarcity has always followed the cycle of resource intensification, population boom, resources depletion and flattening or falling economic growth until the next round of intensification and growth. Water is expected to become an explosive political and economic problem by the middle of the 21st century as the population is ballooning leading to depletion of water resources as argued by [37]. However, for sustainable development to take place around the globe, the issue of sustainable abstraction, use and environmentally friendly recharge of the water system must be given priority in order to ensure that the UN SDGs 1, 2, 3, 4, 5, 6, 10, 11, 12, 13, 15, 16 and 17 are met by the target year of 2030.

4.2. Challenges to sustainable water resources development in Nigeria

In line with the definition of IWRM by the GWP [34], sustainable water resources development links water management with a nation's economic and development planning, including the social, technological and environmental development [9, 70, 71]. The overall picture is for the planning of water resources development that considers present needs while ensuring future water requirements as well. The economic and development planning is therefore in accord with the strategic goal of the SDG 6 and others as listed in section 4.1 which provides for clean water and sanitation for a nation (social, group of people) using the most recent technology (soft and hard) to ensure that the environment (ecosystem) is not adversely affected.

The challenges faced by the RBDAs in Nigeria and ancillary agencies in terms of sustainable water resources development are similar to those of other developing countries albeit specific to the social, political, economic, and cultural realities in the country. A number of these challenges are listed below.

(i) There are 12 RBDAs currently for a population of more than 180 million over an area of 923,000 km^2 [9,12]. These RBDAs also lack adequate human resources to carry out their statutory functions efficiently.

(ii) Currently, there is centralized governance and financial management from the ministry of water resources. Each unit, though with its budget, does not have the financial autonomy to make decisions on capital expenditure.

(iii) The bottom-up approach to development planning may involve too many stakeholders as exemplified in section 3.5 case study with possible loss of focus.

(iv) Lack of budgetary discipline to follow through plans and realise their goals. The lack of control, though, is not peculiar to one ministry alone as it is typical of the country's national planning and implementation.

(v) Planning at the national level, that is, the Ministry of Water Resources does not accommodate major stakeholders such as private sector organisations, contractors, and end-users.

(vi) It can be challenging to manage the effective coordination of the ministry, various RBDA boards and state water agencies. Lack of synergy especially when political considerations are involved creates bottlenecks.

(vii) At the board levels, there are challenges of leadership within and across sectors and this can affect project implementation negatively.

(viii) Lack of quality data where they are available also affects both the design and implementation of sustainable water resources development schemes.

(ix) More often than not, at the state water agencies, as well as at the national level, decisions on new schemes to be embarked on are influenced by political considerations without considering expert advice. In such situations, the planning units are reduced to mere archives for contract agreements and contraction certificates [10].

(x) The use of modern technology in project planning and execution is usually limited to projects with funding from donor agencies such as the World Bank, USAID, DFID, and the European Union. The system design approach of checking physical, environmental,

technological and economic constraints are not considered fully or integrated into the plan.

(xi) Long-term planning or whole system planning that recognises the design, construction, operations, maintenance, environmental rehabilitation or remediation and decommissioning are more often overlooked as theoretical concepts that are not considered in water resources planning in the country.

(xii) Project financing by multi-lateral or multi-national agencies sometimes does not align with the end user's objectives. Such lack of harmony especially in terms of financing modalities and execution leads to project abandonment at various stages.

5. Lessons from the experience of other countries

One key ingredient for the successful implementation of IWRM as seen from the countries reviewed is good water governance. This encompasses the systems responsible for the development, management, and delivery of water services in a society. Good water governance is marked by inclusiveness, responsiveness, accountability, and transparency – elements which have been lacking in the Nigerian context. The importance of good water governance is evidenced in Bangladesh where a participatory approach was adopted to avert crisis in the country's vast wetlands and in Denmark where national, provincial and local authorities had to synergise to prevent water shortages. In these two countries, informed stakeholder participation was guaranteed, policies were formulated to create an enabling environment for water sector reform, community-based initiatives were set up in partnership with donor agencies, and the decision-making processes were transparent [38].

While integrating IWRM into national policy is important, it is necessary for the water policy to be in line with the country's development strategy and governance approach. In the case of South Africa, there has been moderate success in certain aspects of the water sector, especially in stakeholder involvement in the decision-making process. This success is attributable to the fact that the water reform in South Africa was underpinned by political change and as such all areas of the country were undergoing significant reform [38]. This allowed the water policy to be aligned with the country's broader development priorities and ultimately led to more reliable supplies to key water users, economic growth, reduced pollution and better wastewater management [72].

Also, in the countries where an integrated approach to water management was successfully implemented, it can be seen that IWRM was not applied as a checklist of actions. Instead, they set out to solve water problems within their respective localities by adopting a more holistic perspective to managing water. For example Tunisia adopted an integrated approach in managing the country's limited resources in response to a local problem – specifically pollution of water courses [72]. From the success of the approach, the rest of the water sector was able to evolve until the current water policy. The result is that the country is reputed to have achieved the highest access rates to water supply in North Africa and the Middle East despite being one of the least endowed in the region [3].

Finally, from the literature reviewed, it is obvious that there is no one-size-fits-all approach to IWRM. Many of the countries with significant success in managing water resources for national growth took completely different approaches while maintaining the bigger picture of implementing IWRM principles. It is even common to see approaches to water management change within a country as new problems arise and social priorities change. This was the case in Chile as its water policy evolved over time to balance economic efficiency with social equity and environmental sustainability [38].

These two African countries – Tunisia and South Africa - were chosen to compare with Nigeria being in the same continent and with the similarity of social and environmental factors while Chile is described just like others as a less developed country.

6. Conclusion and recommendations

From the observations of IWRM implementation in other countries, it is evident that formulating clear and detailed policies is usually the first step in ensuring that water resources are managed in an integrated manner in practice. It is clear from the legal instruments reviewed and from the current state of the water sector in Nigeria that the existing water legislation is incomprehensive and lacking, and does not set a clear path for solving the water problems in the country. This is shown in the establishment of a national IWRM commission in Nigeria without any apparent framework for the practical implementation of IWRM principles. From this, it is clear that IWRM is seen just as a checklist of actions in response to exogenous pressures from donor agencies without any real political commitment or investment towards implementing the principles in the real world. It is important, moving forward, for Nigeria's water policymakers to identify key problems in the water sector and develop an integrated approach to solving these context-specific problems. This process should include stakeholders from all levels for it to produce positive results as indicated in the case study in section 3.5 earlier. The case study shows the benefits in involving all stakeholders (including women as key water users) in decision making, which conforms to the SDG goals 1, 3, 5, 6, 10, 11, 12, 13 and will lead to water security in Nigeria.

Water governance in Nigeria will benefit greatly from building strong institutions that are responsive to the needs of their host communities and can adapt quickly to changes in the water sector. These institutions will need proper equipment and technical capacity to function adequately. In order to make informed decisions, these institutions will need to develop capacity to collect and store crucial hydrological data. Such data is needed for proper management and to ensure sustainable development of water resources in the country. Agencies like NIMET, NIHSA, and the RBDAs, which are in charge of collecting data like rainfall, stage height and river discharge seldom carry out their functions effectively and these necessary data are neither networked nor managed efficiently to further sustainability in the development of water resources in Nigeria. The recommendation for IWRM is meant to benefit Nigeria water resource development and ensure that it is fit for purpose.

The benefits realizable through appropriate cost recovery measures in line with marginal cost pricing principles of water supply assures of meeting the demand of water for the present generation and taking care of the environmental challenges and preservation for future use. Cost recovery approach of water delivery will ensure that water users use them efficiently hence a reduction in unnecessary wastages. Therefore, public water supply will not be seen as public good that need not be accounted for by the end user. The implication is that demand for water will minimize to such a level that supply can be fairly guaranteed leading to adequate provision for proper treatment of water and also maintenance of the environment of water use. Current problems of water resources management in Nigeria is a stepping stone through the lessons learnt from other nations to Nigeria's integrated water resources development in terms of accommodating all stakeholders in decision making on the issue of water and its utilisation. The target is for the achievement of the envisaged year 2030 United Nations goal 6 of providing clean water and sanitation and serve as input for the building of sustainable cities and communities as expected in SDG goal 11 and others.

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